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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Electrical Connectors

We, PAINTON & COMPANY LIMITED, a British Company, of Beaufort Drive, Kingsthorpe, Northampton, Northamptonshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

- This invention concerns improvements in or relating to electrical connectors, and in particular so-called plug and socket connectors, of the kind (hereinafter described as the "kind referred to") wherein metal electrical contacts are retained in cavities in electrically insulating carriers or mouldings (hereinafter called "carriers") constituting the insulating holders of the plug and socket of the connector, the arrangement being such that when the said carriers are brought together, the contact or contacts in the one carrier mates or mate with the corresponding contact or contacts in the other carrier, provision being made for connecting wires to the metal contacts at positions remote from their mating ends so that when the contacts are mated, the wires or cables (hereinafter called "wires") connected to the one part of the connector are electrically connected to the appropriate wires of the other part of the connector.
- According to one aspect of this invention there is provided for a plug and socket connector of the kind referred to, an insulating carrier having at least one cavity to receive an electrical contact, said carrier having around the area of the front surface thereof, i.e. the surface to be presented to the similar surface of another carrier when an electrical connection is to be made, in which said cavity is located, a wall or rim (hereinafter called a "rim") projecting forwardly from said front surface of the carrier, a perimetrical portion of said rim being inset with respect to the remainder of the rim and having its front surface substantially coplanar with and separated at its ends from the front surface of

such remainder, the arrangement being such that, when two such carriers are presented to one another with the inset portion of the rim of one carrier in register with the remainder of the rim of the other, the said inset rim portion of each of the two carriers respectively slides within the said remainder of the rim of the other carrier, thus effecting accurate registration between the two carriers and the retention of these parts against relative movement in the plane of the said front surfaces thereof.

According to another aspect of this invention, there is provided a plug and socket connector of the kind referred to, wherein the insulating carriers for the contacts are provided around the areas of the front surfaces thereof in which the cavities for the contacts are provided, each with a rim projecting forwardly from said front surfaces of the carriers, a perimetrical portion of each said rim being inset with respect to the remainder of the rim and having its front surface substantially coplanar with and separated at its ends from the front surface of such remainder, the arrangement being such that, when two such carriers are presented to one another with the inset portion of the rim of the one in register with the remainder of the rim of the other, the said inset rim portion of each of the two carriers respectively slides within said remainder of the rim of the other carrier, thus effecting accurate registration between the two carriers and the retention of these parts against relative movement in a plane transverse to that in which they are presented to one another when making the connection.

It will be appreciated that the ends of the inset and remainder portions of the said rim of each carrier constitute shoulders which slide over the corresponding shoulders of a second carrier when two such carriers are interengaged together, thus ensuring registration of the two carriers together. The rim portion of the or each carrier may be in-

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[Price 4s. 6d.]

- wardly spaced from the periphery of the latter; but preferably such rim portion is continuous with the outer surface of the carrier. The arrangement may then be such that when two carriers are brought into mating engagement their peripheral outer surfaces are substantially flush with one another.
- The carrier parts will preferably be moulded from an appropriate thermoplastic or other suitable synthetic resin. They may be of circular, square, rectangular or other required peripheral shape, and each carrier may be furnished with one or any suitable number, e.g. two to thirty or more, of contacts.
- Carriers for use in an electrical connector and constructed as above described may be used in electrical connectors where the mating contacts of the two mating carriers of the connector are of different forms, e.g. those of the one carrier serving merely as sockets and those of the other serving as blades or plugs but, according to a further feature of this invention the contacts of each of the carriers each include a blade adapted to project into and engage a similar blade of a mating carrier.
- According to a further feature of the invention mating contacts of mating carriers may be identical with one another. Thus the two connector parts can be identical in every respect and considerable expense can be saved in the production of the plug and socket connectors as well as simplification in the stocking and servicing of such connectors.
- Desirably the blade of each contact may be formed of a resilient or springy metal and doubled back upon itself approximately hairpin fashion to ensure that mating blades of mating carriers will be resiliently urged together.
- Preferably the doubled back portion of each contact blade will be on the side of such blade remote from that which is intended to make contact with a similar blade. If desired each said contact blade may be provided with means for stiffening the parts thereof adapted to contact a similar blade. Such stiffening means may comprise one or more longitudinal ribs or a flange on one or both longitudinal edges thereof or both such rib or ribs and such flange or flanges. The action of such stiffening means may be such as to ensure that the portion of the contact element which is adapted to engage another contact element remains substantially flat when the two contact elements are brought into their engaging positions, only the doubled back portions of the two contact elements being resiliently deformed as they are brought into engagement. Moreover, the fact that the contacting portion of the two contact elements are thus maintained substantially flat ensures that the surface area in engagement is relatively large.
- If desired means may be provided on the contact blade for interengagement in a groove or recess in the wall of the cavity of the carrier in which the contact is mounted to limit the extent of movement available to the contact blade perpendicular to its contact surface.
- If desired the contacts may each incorporate a blade and a part serving as a socket for receiving the blade of a similar contact.
- According to a further feature of the invention the said rims on the carriers may project from the front surfaces of the latter to such an extent as to protect or guard protruding contact parts of the carrier even when the carriers of the coupling are disconnected. Preferably the extent to which the rims project from the front surfaces of their carrier is somewhat greater than the extent to which any contact part projects from such front surfaces in order to ensure that carriers being mated together are correctly aligned prior to the actual interengagement of the contacts of such carriers.
- Further features of the invention will become apparent from the following description of certain embodiments of the same, and the appended claims.
- In order that the nature of the invention may be more readily understood, certain embodiments of the same will now be described with reference to the accompanying drawings, in which:
- FIGURE 1 is a perspective view, shown partly exploded, of one electrical connector constructed in accordance with this invention; FIGURE 2 is a similar perspective view to that shown in Figure 1 but illustrating an alternative form of electrical connector constructed in accordance with this invention; FIGURE 3 is a vertical fragmentary enlarged section on line III-III, Figure 1; FIGURE 4 is a similar section to Figure 3 but showing the two halves of the connector mated together; FIGURE 5 is a section on line V-V, Figure 3, and illustrates a slight modification of the contacts there illustrated; and FIGURE 6 is a perspective view of a modified form of contact including both a blade and a socket.
- Referring to Figures 1, 3 and 4 of the drawings it will be seen that the electrical connector there illustrated comprises two parts or halves including identical moulded synthetic resin electrically insulating carriers 1 and 2 each carrying a corresponding series of electrical contacts 3 correspondingly arranged in their respective carriers.
- Since the two halves 1 and 2 of the connector are identical the following description will be applicable to both.
- The carrier 1 is of rectangular form in plan and is furnished with a series of cavities or channels 4 extending therethrough and each adapted to receive an electrical contact 3, all the cavities 4 being identical in form and ex-

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- tending completely through the carrier as clearly seen from Figures 3 and 4. The form of the cavities will be subsequently described.
- On its front surface 5 the carrier has a rim 6 surrounding the area of the front surface 5 of the carrier in which the cavities 4 are located, the rim 6 having a part 7 inset from the remainder 8 of the rim to an extent approximately equal to the thickness of the rim, the two parts 7 and 8 of the rim having their ends 9 and 10 separated from one another by narrow gaps 11. Such ends 9 and 10 serving as guide shoulders which, when two carriers such as the carriers 1 and 2 are mated together, serve to align the carriers and guide them in their interengagement. It will be appreciated that when mating two such carriers together the inset rim portion 7 of the one carrier slides within the remainder rim portion 8 of the other carrier until the front surface of the rim 6 of the one carrier engages the front surface 5 of the other carrier.
- The inset and remainder portions 7 and 8 of the rim 6 each extend over half of the length of the perimeter of the carrier so that the carrier may serve for either half of the electrical connector, all the carriers thus being interchangeable. It will be seen from the drawing, when the two carriers 1 and 2, are interengaged, their exposed peripherical surfaces are flush with one another.
- The contacts 3 of each of the carriers are identical in form and have blades 12 which project forwardly from the front face 5 of their respective carriers and it will be seen that the rim 6 constitutes a mechanical and electrical guard for these projecting contact blades.
- In order to enhance the said protection for the contact blades 12 and further to facilitate the accurate alignment of the two halves of the connector before the interengagement of the contact blades of the one half with the blades of the other half, the rims 6 are extended forwardly from the front surfaces 5 of the carriers 1 and 2 to an extent exceeding the length of those parts of the blades 12 of the contacts 3 which project forwardly from the front surfaces of their respective carriers.
- The preferred form of the electrical contacts 3 is shown on an enlarged scale in Figures 3 and 4. These electrical contacts are each conveniently formed from a stamped out blank of resilient or springy metal sheet or strip such as hard copper, phosphor bronze, beryllium copper or nickel silver sheet or strip of appropriate thickness, say, for example, .017", the blank being shaped so as to provide a rectilinear blade 13 integral with a shank 14, the blank including at one end of the shank 14 a pair of laterally extending lugs 15 which are bent inwardly over the said shank towards one another to provide means for gripping the insulation of an electric conductor such as 16, the bared end 17 of the core of which is electrically connected to the shank 14, forwardly of the lug 15, by welding or soldering or in any other suitable manner. The contact is furnished with a further pair of lugs 18 projecting from the shank in parallelism substantially at right angles to the plane of the shank, these lugs serving for locating the contact in the rear end portion of the cavity 4 of the carrier.
- The blade 13 is of such a length as to project forwardly beyond the front surface 5 of the carrier 1 in which the contact 3 is mounted, the blade 13 being doubled back upon itself approximately hairpin fashion to provide a resilient arm 19 of a somewhat bowed form and cranked outwardly towards its free end so as to provide a heel 20 adapted to snap into a recess 21 in the front end of one wall of the corresponding cavity 4 in the carrier 1 when the contact is introduced into this cavity from the rear of the carrier and pushed forwardly until the front ends of the locating lugs 18 engage a shoulder 22 in the same wall of the cavity as the recess 21, the contact thus being locked against accidental endwise movement in the cavity. Withdrawal of the contact 3 from the carrier 1 can be achieved by disengaging the heel 20 of the contact, by means of a suitable tool, from the base of the recess 21.
- The surface 23 of the contact blade 13 is the surface which is adapted to make electrical contact with the corresponding surface of a co-operating contact blade of the other half of the connector and such surfaces 23 are preferably faced with a precious metal such as, for example, silver, there conveniently being a coating of silver of about .002" thickness. The contact blade 13 may be longitudinally stiffened if desired by furnishing it with a return flange 24 along each longitudinal edge thereof, each such flange conveniently being integral at its rear end with the locating lug 18 on the corresponding side of the contact but, if desired, the flanges 24 may be cut away as indicated in dotted lines at 25, Figure 3 to give the contact blade an increased degree of flexibility at this position and this cut away may extend slightly into the longitudinal edges of the blade 13 itself.
- The front end of each cavity 4 in the carrier is provided with a recess 26 in the wall thereof opposite to that in which the recess 21 is provided, this recess 26 having a flared mouth 27 and serving to receive a forwardly projecting part of the contact blade which is to mate with the contact blade in the cavity in which the recess 26 is provided, as shown in Figure 4. The doubled back portion 19 of the contact blade 13 is bent at a relatively sharp angle with respect to the main portion of the blade. As the two parts of a connector are brought into the mating position shown in Figure 4, this sharply bent portion of each contact element 13 can readily be introduced into the corresponding flared recess 27 of the

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other part of the connector, and the inclined wall of the flared recess 27 acts as a ramp which co-operates with the sharply bent portion to ensure that the contact element 13 of which the latter forms a part is guided into the correct mating position, even if the two parts of the connector are not brought together in exactly correct alignment.

The recess 26 has a dimension measured at right angles to the surface 23 of the contact blade 13 less than the dimension between the said surface of the contact blade and the parallel wall of the recess 21 so that when the contact blade of the co-operating connector half is introduced into the recess 26 as shown in Figure 4 the arm 19 of the contact blade of the latter connector half is compressed towards its blade 13. Thus when the two halves of the connector are mated together the resilient arms 19 of the mating contact blades 13,13 are compressed inwardly towards their respective blades and a transverse thrust in opposite directions is applied to the two mating blades in order to ensure that these make good electrical contact.

If desired the extent of lateral displacement of the contact blades 13 may be limited by furnishing the flanges 24 of these blades with out-turned flanges 28 as shown in Figure 5, these flanges engaging in longitudinal recesses 29 in the longitudinal side walls of the corresponding cavities 4 in which the contact blade is located.

The construction of the connector shown in Figure 2 is substantially the same as that described with reference to Figures 1, 3 and 4 although the connector of Figure 2 is of a different external shape and the inset portion of the rim 7¹ is semi-circular whilst the inner surface of the remainder of the rim 8¹ is similarly semi-circular, the external perimeter of the carriers 1² and 2² being approximately diamond-shape.

Figure 6 illustrates in perspective an alternative form of contact which comprises both a plug and a socket. In this case the contact comprises a blade 13² integral with a shank 14² furnished at the end remote from the blade with lugs 15² for gripping the insulation of the electrical conductor 16² of which the bared wire 17² is clamped to the shank 14² by turned over lugs 30 with or without welding or soldering.

The rear part of the blade 13² is furnished with a pair of oppositely located lugs 31,32 which extend initially outwardly from the blank in opposite directions and then are rolled over inwardly towards one another to form a spring clip into which the corresponding contact blade 13¹ of a mating contact may be pushed to be gripped firmly by this clip, the forward inner corners 33 of the clip-forming lugs 31 and 32 being rounded or shaped to present a flared mouth to a mating blade

being inserted into the clip. A U-shaped slit 34 is formed in each of the lugs 31 and 32 so that when these lugs are rolled inwardly a pair of tags 35 are provided which project from the plane of the blade 13² substantially at right angles, these tags being provided to locate the contact in its cavity 4¹ in the carrier against movement transversely of the length of the contact rather in the way that is achieved by the lugs 18 previously described. These tags may also co-operate with shoulders in the corresponding cavity to prevent endwise movement of the contact in the carrier. Alternatively, or in addition, the shank of the contact may have pressed out tongues 36 inclining in opposite directions and adapted to engage a projection in the cavity of the carrier to prevent endwise movement of the contact relatively to the latter.

The blade 13² may have one or more longitudinal ribs 37 to reinforce and stiffen it.

If desired, a contactless carrier such as the carrier 1 or 2 of either of the forms above described may be used as a protective cover for a contact-provided carrier when not mated with another contact provided carrier but whilst electrically alive.

An electrical plug and socket connector constructed in accordance with this invention provides a number of features that are desirable in such connectors: thus by making the carriers so that they can only be mated together in one way, provision is made for ensuring correct association or polarisation of the mating contacts of the connector and ready alignment of the two carriers is assured so that the contacts mate accurately together even where there are a large number of such contacts in each carrier. The interengagement of the rims on the two carriers ensures accurate alignment of the carriers and accurate mating of the contacts of the two connector halves even where there is some imperfect alignment of the contacts in their respective cavities. Furthermore the rims on the carriers afford for the protruding parts of the contacts protection against mechanical damage or electrical shorting. Moreover the conductor wires can be connected to their contacts 13,13² prior to the assembly of these contacts in their carriers, the contacts thereafter being hidden into their respective cavities 4 from the rear of the carrier and automatically locked against unintentional withdrawal from the carriers. Additionally economical production of the arts is achieved due, *inter alia*, to the construction of the connector so that both halves are identical both with regard to the carriers and the contact parts themselves.

WHAT WE CLAIM IS:—

For a plug and socket connector of the kind referred to, an insulating carrier having at least one cavity to receive an electrical contact, said carrier having around the area of the front surface thereof in which said cavity

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- is located, a rim projecting forwardly from said front surface of the carrier, a perimetrical portion of said rim being inset with respect to the remainder of the rim and having its front surface substantially coplanar with and separated at its ends from the front surface of such remainder, the arrangement being such that, when two such carriers are presented to one another with the inset portion of the rim of one carrier in register with the said remainder of the rim of the other, the said inset rim portion of each of the two carriers respectively slides within the said remainder of the rim of the other carrier, thus effecting accurate registration between the two carriers and retention of these parts against relative movement in the plane of the said front surfaces thereof.
2. A plug and socket connector of the kind referred to, wherein the insulating carriers for the contacts are provided around the areas of the front surfaces thereof in which the cavities for the contacts are provided, each with a rim projecting forwardly from said front surfaces of the carriers, a perimetrical portion of each said rim being inset with respect to the remainder of the rim and having its front surface substantially coplanar with and separated at its ends from the front surface of such remainder, the arrangement being such that, when two such carriers are presented to one another with the inset portion of the rim of the one in register with the remainder of the rim of the other, the said inset rim portion of each of the two carriers respectively slides within said remainder of the rim of the other carrier, thus effecting accurate registration between the two carriers and the retention of these parts against relative movement in a plane transverse to that in which they are presented to one another when making the connection.
3. An electrical connector according to claim 2 wherein the contacts of each of the carriers each include a blade adapted to project alongside and engage a similar blade of a mating carrier.
4. An electrical connector according to claim 3, wherein the mating contacts of the mating carriers are of identical form.
5. An electrical connector according to claim 3 or 4, wherein the blade of each contact is formed of resilient or springy metal and is doubled back upon itself approximately hairpin fashion to ensure that mating blades of mating contacts will be resiliently urged together.
6. An electrical connector according to claim 5, wherein the doubled back portion of each contact blade is on the side of such blade remote from that which is intended to make contact with a similar blade.
7. An electrical connector according to claim 3 or any claim dependent thereon,
- wherein each contact blade is provided with means for stiffening the parts thereof adapted to contact a similar blade.
8. An electrical connector according to claim 7, wherein the said stiffening means comprise at least one flange along a longitudinal edge of said blade.
9. An electrical connector according to claim 7 or claim 8 wherein said stiffening means comprise at least one longitudinal rib along said blade.
10. An electrical connector according to claim 3 or any claim dependent thereon, wherein the contact blade of each contact has means for limiting the extent of its movement in its carrier in a direction perpendicular to the contact surface of the blade.
11. An electrical connector according to claims 8 and 10, wherein said means for limiting the movement of said blade in its carrier comprises means on said flange for engaging in a groove or recess in the wall of the cavity of the carrier in which the contact is located.
12. An electrical connector according to any one of claims 5 to 11, wherein each cavity is shaped so as to co-operate with the doubled back portion of the contact engaged in such cavity, to prevent accidental withdrawal of the contact from the cavity.
13. An electrical connector according to claim 2 or any claim dependent thereon, wherein each said contact includes a blade having an integral part defining one side of a socket for receiving the blade of a similar contact.
14. An electrical connector according to claim 2 or any claim dependent thereon, wherein the said rims on the carriers project from the front surfaces of the latter to such an extent as to protect or guard protruding contact parts of the carrier even when the carriers of the coupling are disconnected.
15. An electrical connector according to claim 14, wherein the extent to which the rims project from the front surfaces of their carrier is somewhat greater than the extent to which any contact part projects from such front surfaces in order to ensure alignment of carriers being mated together prior to the interengagement of the contacts of such carriers.
16. For an electrical connector, an electrically insulating contact carrier substantially as herein described.
17. For an electrical connector, an electrically insulating contact carrier substantially as herein described with reference to Figure 1 of the accompanying drawings.
18. For an electrical connector, an electrically insulating contact carrier substantially as herein described with reference to Figure 2 of the accompanying drawings.
19. An electrical connector substantially

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- as herein described with reference to and as shown in Figures 1, 3 and 4 of the accompanying drawings.
20. An electrical connector according to claim 19, modified substantially as herein described with reference to and as shown in any of Figures 2, 5 and 6 of the accompanying drawings.
21. In an electrical connector according to claim 2, a contact substantially as herein described with reference to and as shown in Figures 3 and 4 of the accompanying drawings.
22. A contact according to claim 21, modified substantially as herein described with reference to and as shown in Figure 5 of the accompanying drawings.
23. In an electrical connector according to claim 2, a contact substantially as herein described with reference to and as shown in Figure 6 of the accompanying drawings.

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Fig.1

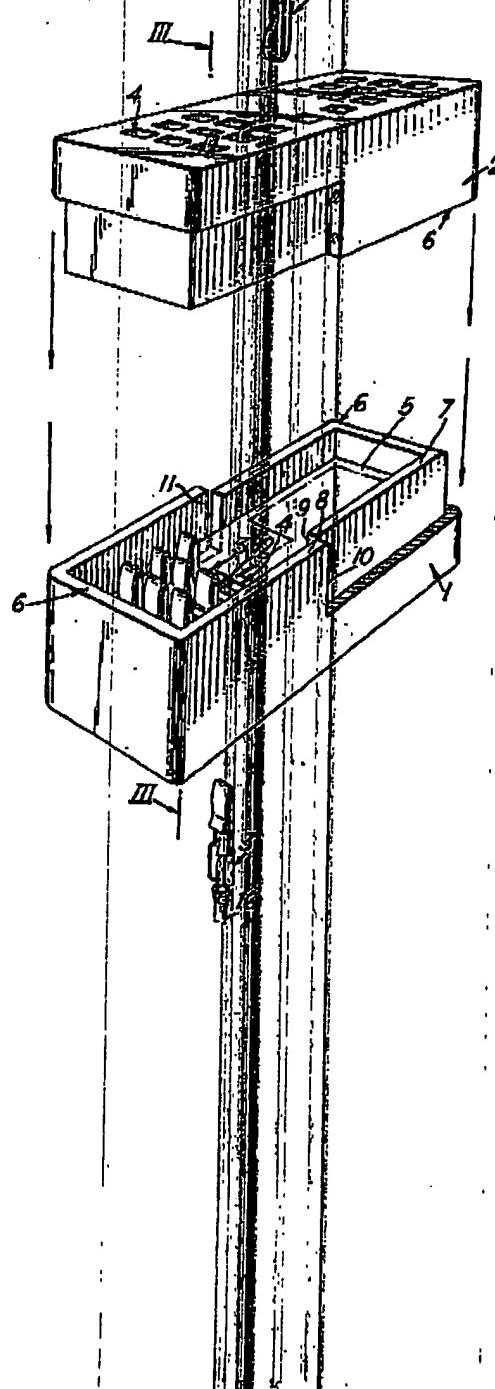


Fig.2

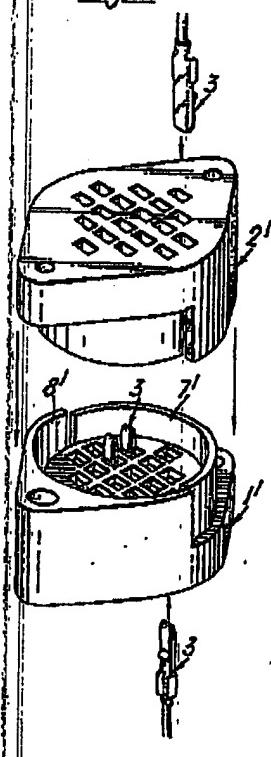
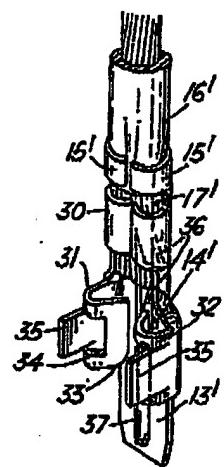


Fig.6

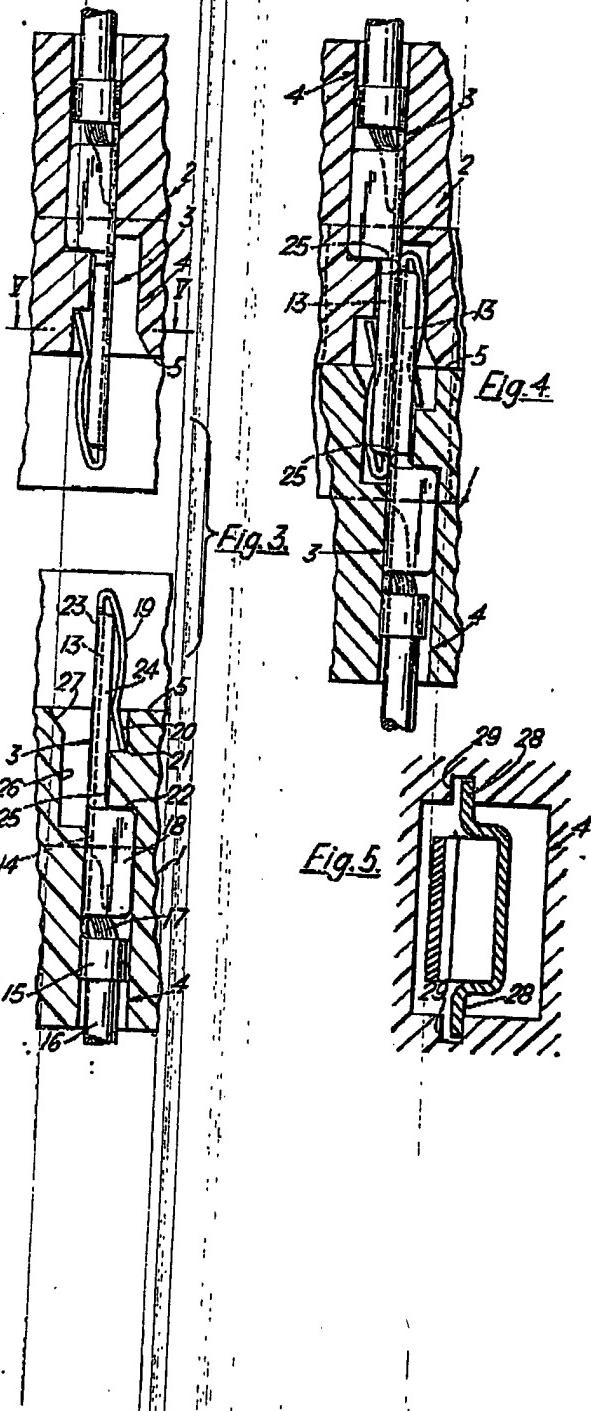


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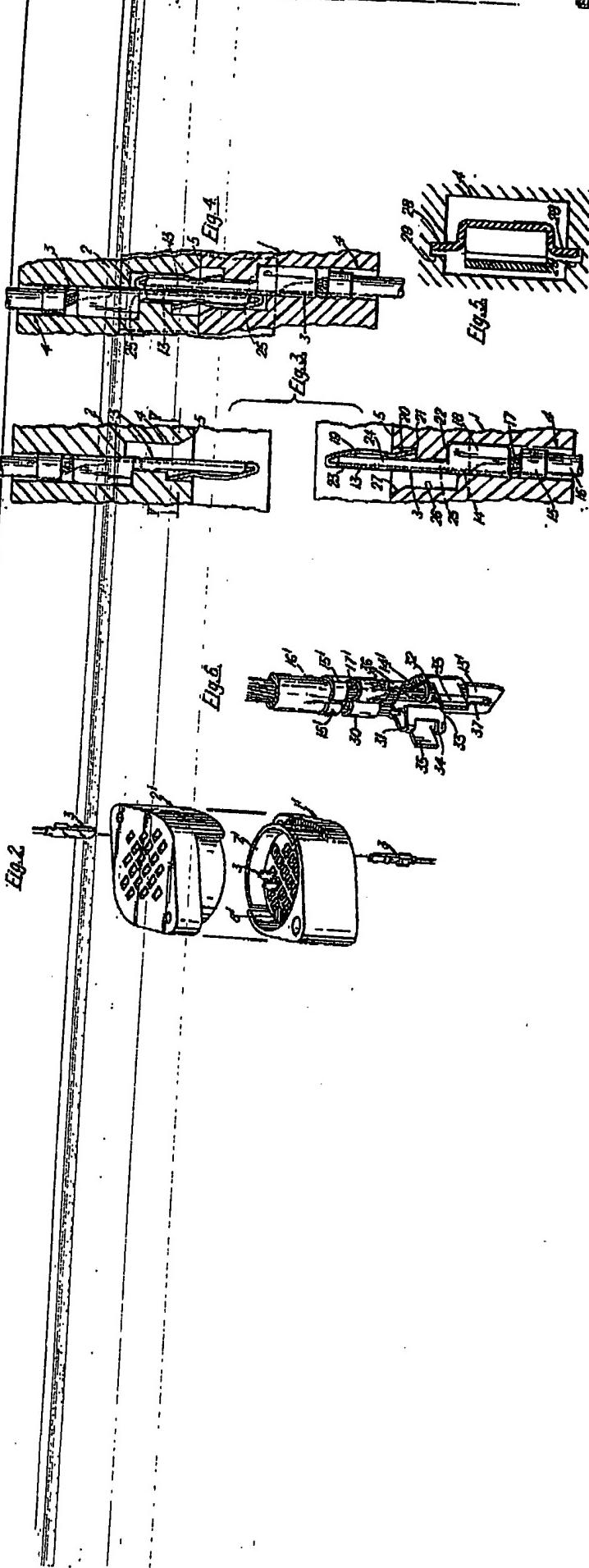
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Fig.6

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